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Phasing out contentious inputs in organic and non-organic horticulture – Organic-PLUS.

Ulrich Schmutz[1], Francis Rayns[1], Nikolaos Katsoulas[2], Anne-Kristin Løes[3], Massimo De Marchi[4], Claus Grøn Sørensen[5] and Adrian Evans[1]

[1] Coventry University, Centre for Agroecology, Water and Resilience, United Kingdom
[2] University of Thessaly, Greece
[3] Norwegian Centre for Organic Agriculture, Norway
[4] Department of Agronomy, Food, Natural Resources, Animals and Environment, University of Padova, Italy
[5] Aarhus University, Denmark

Abstract

Across Europe, there has been an ongoing discussion regarding inputs into organic agriculture and horticulture, which are considered more or less contentious. These discussions have contributed to the decision by the European Horizon-2020 research programme to invest 8 million Euros into two 4-year projects, starting in 2018.
This paper provides research approaches from one of those successful projects from the call: *Organic-PLUS*. The focus is on research relevant to organic horticulture (and non-organic horticulture). This includes alternatives to the use of *copper and mineral oils* used for plant protection, with a special focus on potatoes, perennial Mediterranean crops like olives and citrus and greenhouse crops like tomatoes and aubergines. Further research is on *better organic fertilisers* such as non-animal derived fertilisers, which are compatible with 'Vegan Organic Standards', but also other 'bio-economy fertilisers', which make use of existing resources, like fishpond sediments and marine-derived fertilisers. Alternatives to *peat as a growing media*, an area where peat replacement is most challenging i.e. in specialised nursery crops will also be researched and discussed, and also the increasing use of *plastic mulch materials* and potential impact of plastic and alternative mulch materials on soil pollutants.
We will use the phase-out of peat as an example to discuss voluntary, industry-lead approaches compared to legislative ones, and discuss how this relates to the revised EU organic regulation adopted in June 2018.
The oral presentation of the paper will invite discussion on further contentious inputs and possible phase-out scenarios to strengthen the contribution organic horticulture (and horticulture in general) can make to a true 'Bio-economy' and to 'Wellbeing of the Environment and Population'. Therefore, the Organic-PLUS project is also committed to research broader public concerns about contentious inputs and to further develop science-society dialogue around contentious inputs.

Keywords: *contentious inputs, organic and conventional horticulture, copper, mineral oils, vegan fertilisers, marine-derived fertilisers, peat, plastic, immunostimulatory plant products, phase-out scenario modelling.*

Background

Across Europe, in the European Union (EU), and within the IFOAM-EU group (International Federation of Organic Agricultural Movements) specifically, there has been an ongoing discussion regarding inputs into organic agriculture and horticulture, which are considered more or less contentious. These discussions have been ongoing since the EU regulation for plant production and livestock production were introduced in the last decade of the previous century. This debate has triggered discussion on stricter private and public standards in different European countries, and also among different private certification bodies. In addition, this debate has also contributed to the decision by the European Horizon-2020 research programme to invest more than 8 million Euros into two 4-year projects, starting in 2018 (call SFS-08-2017: Organic inputs – contentious inputs in organic farming). This paper provides an overview and research approaches from one of the successful projects in the call: Organic-PLUS, led by Coventry University's Centre for Agroecology, Water & Resilience. The focus is on research relevant to organic (and non-organic) horticulture.

In the recently adopted new organic regulation 'Regulation EU-2018/848', published 14.6.2018 in the Official Journal of the European Union, most contentious issues mentioned in the call SFS-08-2017 are still allowed, however more or less tightly restricted, and few phase-out scenarios are set (European Parliament Regulation EU-2018/848, 2018). This is true for copper, mineral oils, antibiotics, peat, and fertiliser derived from conventional inputs. One case were a phase-out is written into the new regulation is for conventional manure where the wording in section 1.9.2. (c) is *"The fertility and biological activity of the soil shall be maintained and increased…by the application of livestock manure or organic matter, both preferably composted, from organic production".* Reference to non-organic manure is however made for mushrooms where farmyard manure has to come *"either from organic production units or from in-conversion units in their second year of conversion; or… only when the product…is not available".* A further case where a phase-out is written into the new regulation is for organic greenhouses using demarcated beds (these are beds with substrate, and living soil mixed or fertilised with materials and products allowed in organic production, but not connected to the sub-soil and the bedrock, mainly used in Nordic EU countries, with winter soil frost). Here the derogation (or 'phased-out' period) runs until 31 December 2030 with an earlier deadline of 2025 for the commission to provide a legislative proposal for demarcated beds (Regulation EU-2018/848, 2018) e.g. to discuss exceptions already proposed for urban rooftops or contaminated soils (Schmutz et al., 2014).

Overview of the Organic-PLUS project

'Organic-PLUS' means minimising, and eventually phasing out contentious inputs from certified organic agriculture. By doing so organic food systems can be more true to the IFOAM organic principle of 'ecology'. This principle is now shared by the EU Bio-economy agenda, focusing on renewable biological resources from land and sea. Furthermore, this research is also applicable to non-organic farming systems seeking to adopt more agroecological solutions. This combined focus on organic principles and Bio-economy may not only lead to more resilience and quality assurance within organic production, but also reduced environmental impact and fairer, more reliable rules and regulations that organic consumers (current and new) can trust to "buy-into" the growth of the sector. By reducing dependence on external inputs, also used in conventional production systems, the solutions developed and assessed within Organic-PLUS will also deliver benefits outside certified organic farming systems. The project will provide critical scientific input into the on-going vision and strategy process within IFOAM internationally e.g. 'Organic 3.0 edition 2' (IFOAM, 2016), or any 'Organic 4.0' and TP Organics discussions within Europe.

Organic-PLUS has three large 'topical' workpackages. WP PLANT researches alternatives to copper and mineral oils used for plant protection, working on potatoes, glasshouse crops and perennial Mediterranean crops. WP LIVESTOCK considers the use of natural plant sources of vitamins as alternatives to synthetic products and the remaining use of antibiotics in organic livestock systems. It also considers alternative and novel bedding materials in place of straw from conventional farms. In the work *in-vitro* experiments to characterise the materials are combined with *in-vivo* trials (with sheep, calves, dairy cows, beef cattle, poultry and pigs) to evaluate their effects on animal performance, health and quality of meat and milk. WP SOIL considers alternatives to the

use of manure from non-organic farms and other animal-derived fertility inputs such as blood and bone meal (including legume-based fertilisers in horticultural production, marine derived fertilisers and pond sediments from organic aquaculture). Some of these fertilisers will be compatible to the recently developed private vegan organic standards (Schmutz and Foresi, 2017), e.g. the bio-cyclic-vegan standard was approved into the IFOAM family of standards in February 2018. Organic-PLUS also works on alternatives to peat in growing media (including materials from agroforestry) and alternatives to fossil fuel-derived plastic used as a weed supressing mulch (including degradable plastics and biocomposites).
The topical work is supported by WP IMPACT. This includes collection of information concerning current consumer conceptions of contentious inputs (using surveys and citizen juries), establishment of a comprehensive database of key stakeholders throughout Europe and coordination of dissemination activities. All workpackages feed into WP MODEL where scenarios for the phasing out of contentious inputs from organic agriculture are designed. This includes environmental and sustainability assessments of the proposed alternatives using a variety of life cycle assessment tools. The WP LEAD coordinates the project, ensuring transparent and participatory communication flow across workpackages and among the multi-actor stakeholders but also with business and policy actors in the organic and non-organic food and farming sector in the EU and globally. The creation of the International Scientific Advisory and the European Industry advisory boards maximises impact to industry and policy development.

Phase-out rationales and research approaches

Contentious inputs - consumer research

There is a good broad research base on understanding the organic food consumer and comparing them to consumers of conventional food (Stolz et al., 2011, Bilal Basha et al., 2015). However, this research has mainly focused on the comparison of organic versus conventional. In addition, contentious inputs e.g. copper sprays, blood and bone meal, peat or plastic mulching have not been part of any larger study. Studies often focus on one or few countries (Annunziata and Vecchio, 2016) and do not cover a whole diversity of food cultures. This research is comparing current organic (with contentious inputs) to a different organic (called 'organic-plus') where those are phased-out. In other words, it is a comparison within the current and future growing organic consumer base: i.e. are the contentious inputs to consumers the same as specified in the EU call text SFS-08-2017, what else is contentious to consumers? The project is active in 9 EU countries (and 3 non-EU) covering 384 million consumers (474 million) or 75% (76%) of the population in the EU (non-EU Europe excluding European Russia); the survey covers 7 of them (Norway, UK, France, Germany, Poland, Spain, Italy) and represents 70% of all EU consumers. The survey is followed up by in-depth studies with citizen juries in the Norway, UK and Italy.

Phasing out Copper and Mineral Oils

Many contentious inputs in organic (and conventional) plant production are directed towards plant health. Copper applications have been used primarily to control diseases caused by Oomycetes and other foliar, shoot and fruit diseases caused by fungi and bacteria. Despite its unfavourable eco-toxicological profile (Flemming and Trevors, 1989), a limited use of copper is tolerated in acknowledgment of its unique properties as a wide-spectrum fungicide and bactericide. Mineral oils are particularly effective against powdery mildews, and may enhance host plant resistance (Northover and Timmer, 2002). Many potential alternatives have been proposed e.g. resistant cultivars, biocontrol methods, system changes, but few have been extensively tested under real farming conditions und uptake of alternatives is slow. Organic-PLUS generates additional knowledge required for optimal use of alternatives, and answers many practical questions important for the uptake, such as duration of elicitation, timing, rates of application, effect of combinations of control measures. The work is with a range of important European crops, and with a focus on Mediterranean crops (annual i.e. aubergines and perennial i.e. citrus, olive), which have seen less investment into organic research than other parts of Europe.

Phasing out synthetic vitamins and antibiotics

Livestock raised under intensive and extensive farming systems can face various diseases that can derive either from rearing condition, nutritional imbalances and deficiencies, or metabolic or infectious diseases. Natural plant sources of vitamins are available and could be further used on organic farms, e.g. *Aloe vera* or essential oils (Surjushe et al., 2008), but specific recommendations and knowledge about the absorption and transfer of natural vitamins to the animal products is still lacking. In response to concerns about the use of antibiotics in animal production and problems with resistant bacteria a range of plant secondary metabolites is researched as potential feed additives for ruminants (Calsamiglia et al., 2007). We ask if organic horticulture or agroforestry can contribute to contentious issues in organic livestock production, by growing natural plant products with immunostimulatory properties.

Phasing out conventional and animal derived fertilisers

For high value horticultural crops, other products derived from conventional agriculture (such as blood and bone meal) are commonly used, but this is particularly unacceptable to a growing number of vegan consumers. There are many potential alternatives, some well-established and others more novel, but there is a lack of information about how these should best be used in practice to match nutrient supply with crop demand (Benke et al., 2017). Organic-PLUS is investigating 'vegan organic fertilisers', which are compatible with vegan organic standards and the optimisation of the use of legume-based fertilisers in organic horticultural production is therefore important. However, there are other 'bio-economy fertilisers' like marine-derived fertilisers (e.g. organic seaweed or fish by-products) and pond sediments from organic aquaculture which are equally of interest to replace conventional manure and by-products from conventional agriculture like Vinasse from sugarbeet.

Phasing out peat as a growing media

Peat is still the most widely used substrate in plant nurseries in Europe (López-López et al., 2016). It is seen as a good substrate for plant growth, being cheap, compactable, low in nutrients but able to absorb and release them from added fertilisers, free from weed seeds and other hazards, and free from heavy metals and other potentially toxic elements. Organic-PLUS examines the use of novel materials (composted and extruded agroforestry products, cocoa shells and composted vine waste) as components of growing media. It focuses on nursery crops and specialist growing media where the peat component is considered most difficult to replace.

Phasing out plastic mulch as soil cover:

Polyethylene plastic covers of films obtained from petroleum or synthetic polymers has been widely used in agriculture for a long time. However, there is growing concern about pollution from micro-plastics and phthalates included as plasticisers (Steinmetz et al. 2016). Biodegradable plastic is available, with less negative effects, but production costs are higher and need to be reduced (Touchaleume et al., 2016) to increase its uptake. Organic farming already utilises organic materials as mulch (e.g. chopped grass/clover) but the N efficiency can be rather low (Riley et al., 2003). Organic-Plus tests the agronomic performance of different mulches under field conditions. The materials will include novel degradable non-fossil fuel derived polymers After the use of the mulch materials (contentious and alternatives toxicological testing of soil is conducted. This is done to understand a potential build-up of organic pollutants as a result of the use of different mulch materials.

Lessons learned from phase-outs - The example of peat in the UK

In 2011, in a visionary and well-minded move, the government f the United Kingdom (UK) passed an 'Environment Paper', which included targets for a complete peat phase-out in the UK. The targets aim for no peat in the consumer sector (retail growing media) by 2020, and no peat used by the professional horticultural sector by 2030. A voluntary task force was formed and after five years of extensive deliberations a voluntary 'Responsible Sourcing Scheme' was created to measure impacts on energy use, water use, social compliance, habitat and biodiversity, pollution,

renewability, and resource use efficiency. The hope was (and still is) that the scheme improves the sustainability of this part of their businesses, however the scheme was still not ready by 2018, seven years after the target was set and two years before the first deadline in 2020. This may be interpreted as a deliberate attempt by the stakeholders involved to delay the phase-out. In the meantime, the UK government has not introduced the most obvious legislation e.g. requiring manufactures to label ingredients of growing media bags, as food producers are legally required to do. Conroy (2016) notes, that without clear labeling consumers are confused with 'reduced peat' labels still having up to 90% peat and some composts not stating ingredients at all or other dubious claims like *"not from an environmentally sensitive site"* (Conroy, 2016). Helpful was that some sustainability-conscious retailers have started to stock only peat-free compost and are leading a phase-out by positive example.

There are also powerful retarding forces against a phase-out e.g. the horticultural supply industry in the UK and elsewhere in Europe has got 'used to peat' including robots for transplanting with this 'easy-going' substrate. However, even responsible industrial exploitation of peatlands causes severe environmental damage, biodiversity loss and disproportionally large carbon emissions, making peat classified as a young fossil-fuel (Conroy, 2016). Composts, coir materials, bark and wood fibre products are 'bio-economy' raw materials which are used (Neumaier and Meinken, 2015), but there are problems with continuity of consistent supply, nutrient and water management that currently deter commercial producers from using them, even in small proportions in a growing media.

As Waldron et al. (2013) finds retaining cell wall structure is key in producing growing media with similar or better qualities than peat. They also give the way forward for a technical solution where bio-economy based growing media are used: controlled composting to retain plant cell wall structure and then *"blending structurally-sound material with small quantities of…structured composts"*, or reclaimed peat or other plant based material e.g. from agroforestry supply chains, processed to add plant cell structure in a growing media blend. In the most recent Acta Horticulturae ISHS-1168 documenting the 'International Symposium on Growing Media, Composting and Substrate Analysis' the number of papers researching peat alternatives has increased considerably from previous publications, which barely discussed the issue (Baumgarten et al. 2017). In ISHS 1168 plant biomass from heathlands in Germany is proposed with encouraging results for at least 50% peat substitution (Wissner et al. 2017), while others found benefits in vermicompost and green waste compost, however still retaining 25% peat. In contrast to this untreated hydrochars (made by hydrothermal carbonisation, unlike biochar made by pyrolysis) caused *"severe problems"* in organic grown potted herbs, due to a strong nitrogen immobilisation (Neumaier et al. 2017). In addition, there were slight phytotoxic effects, overall a high-risk strategy. All this shows that some results indicate promising leads, but more research is required.

Concluding considerations

It can be concluded that phase-outs take time than – much more time than the UK government initially hoped for, at least in the case of the peat phase-outs. More research in alternatives is still needed and the Horizon 2020's 8 million Euro is a useful investment and step in this direction.

Voluntary phase-out schemes are useful to raise awareness of the issue among the industry, horticultural growers, private gardeners but ultimately, they can also be used to delay the issue and, as they are voluntary or so-called 'industry-lead', they lack the rigour and commitment legal frameworks provide. For example, a phase-out commitment in the next update of the EU organic regulation (European Parliament Regulation EU-2018/848, 2018), as described above for conventional manure or demarcated beds, would certainly change the situation for the organic sector and would create an accelerated rush to develop alternatives.

In addition, simple but legally committing EU-wide labelling rules for all ingredients in growing media and compost, would make consumers more aware of the issues and give an informed choice. These product ingredient labelling has shown to be helpful to inform consumers about ingredients in food, but has presently excluded any contentious inputs going beyond the ones used in organic farming, e.g. the fact that if imported GM feed is used to produce conventional meat in Europe, it is not required to shown this as an input ingredient on food labels, or the fact that animal by-products from intensive in-door factory farming (not free-range or organic) can included in wine is

equally not visible for consumers of conventional or organic food and drink. These are important EU regulatory omissions where contentious inputs can be 'hidden from consumers' and trigger further private labelling like vegetarian and vegan wine.
It is also important to consider the global implications of any changes to the EU organic standards. As Martin Häusling, the Member of the European Parliament (MEP) responsible for steering the plans through the EU parliament, points out for the revised EU organic regulation: *"the harmonisation of production standards for [non-EU] countries… will bring them into line with European standards. The new rules on imports are also positive for the consumer, as they will benefit from the harmonisation of high standards"* (European Parliament, 2018). The Organic-PLUS project has therefore an international advisory board to discuss the global implications of any future phase-out or labelling scenarios.

In the case of peat phase-out, the steady increase of research on peat alternatives also shows that the awareness is slowly but steadily rising across Europe, or worldwide, and that research into alternatives needs time. Although it currently looks unlikely that the ambitious phase-out of peat in the retail sector in 2020 will be met in the UK or anywhere else in Europe, the direction of travel towards an eventual phase-out of all large-scale industrially mined peat, also as a capping for organic mushroom production is set. Innovative supply chain actors, retailers and charities already have positioned themselves on the side of the bio-economy alternatives.

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